THE TECH

SPECIAL ISSUE--DEPARTMENT OF BIOLOGY.

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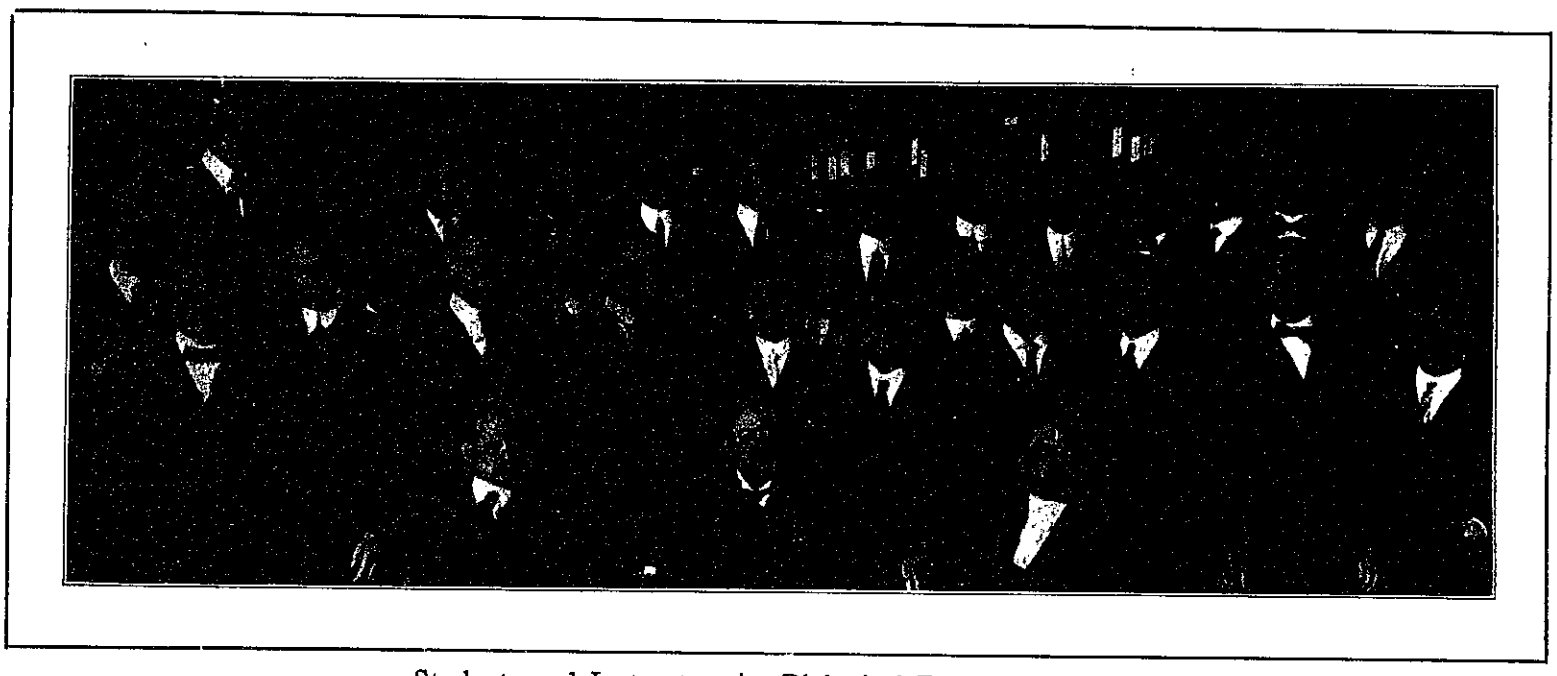

Students and Instructors in Biological Department.

GENERAL BIOLOGY

By C.-E. A. WINSLOW.

Instruction in all biological subjects begins with a course in General Biology. At many institutions Botany and Zoology are taught as separate branches. It is believed in the Biological Department of the Institute that a much broader and more balanced conception is attained by studying the fundamental laws that underlie the activities of all living things, before the specific characters of different types are brought under review. Accordingly, after a few introductory exercises on the organization of living bodies, their component organs, tissues and cells, and the composition and properties of protoplasm,—the physical basis of life.—a single typical plant and a single typical animal are studied in considerable detail. In these types, the fern and the earthworm, the student is led to see how plant and animal organisms are built up, how their various systems of organs do their individual work and react upon each other, and how the organisms reproduce and pass through their life cycle of development. Finally, the inter-relation of different forms of life is illustrated by a study of some of the simpler microbic organisms, yeast, bacteria and infusoria, which display on a small scale in the hay infusion some of the broader problems which underlie the maintenance of life on the globe.

The primary aim of this course is to acquaint the student with the underlying principles of structure and function and development as exhibited in all living things. Second only in importance is training in close observation and the cultivation of habits of sound induction, to which the study of a complex living machine lends itself with peculiar fitness. To this latter end the lecture treatment is strictly subordinated to laboratory and quiz work.

A long course of five hours a week in this subject forms the introduction to all future work for students in Course VII.; a brief course of one hour a week is designed to serve a similar purpose for chemists and engineers, specializing in biology. Either of these courses is also adapted for the student

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A BRIEF HISTORY OF THE DEPARTMENT OF BIOLOGY

By W. T. SEDGWICK.

Some instruction in biological subjects was offered at the Institute from the very start, for we find that in the First Annual Catalogue, published in 1865, one of the six courses, namely, that in General Science and Literature, included, nominally at least, instruction in Zoology, Botany and Paleontology, as well as Physiology, and Comparative Anatomy.

Under the head of "General Studies," a term which we still employ to describe such subjects as Political Economy, the History of Science, English Literature, and the like, it was stated that "instruction will be given to regular students during the Third and Fourth Years" in various subjects, among which were Zoology, Physiology and Botany.

Several years later a special course in Natural History was established in which instruction was given mainly in Zoology, Botany, Microscopy, and allied subjects. Dr. Kneeland, long the Secretary of the Institute, also lectured upon Human Physiology, and a skeleton which he is said to have used in those lectures is now in the possession of the Biological Department.

General Francis A. Walker, on assuming the Presidency of the Institute, brought to it many of the ideas with which he had been impressed during his service as a professor in the Sheffield Scientific School of Yale College, and among others the conviction that a course in Biology preparatory to medical studies would prove useful. Such a course had in fact been successful in the Sheffield Scientific School, and there seemed no good reason why a similar course should not be developed in the Institute. Much was being said at the time about reforms in medical education; the Harvard Medical School had, a few years earlier, established, as the first among American medical schools, an entrance examination, and there was promise of a new and better medical school soon to be open at the Johns Hopkins University in Baltimore. General Biology, Physiology after the German model, and Embryology were also gaining prominence over the older and more classificatory studies of the Agassiz period, while Microscopical Botany and Vegetable Physiology were beginning to excite a considerable interest among the newer school of Botanists—especially those trained abroad.

There was, moreover, a good deal of friction within the old Natural History Department itself, especially between the Zoological and the Botanical and Microscopical sub-departments, so that very soon, namely in 1883, General Walker determined to bring in some new blood and to change radically the general character of the Natural History instruction.

To this end he invited the writer, who at that time was an Associate in Biology at the Johns Hopkins University, to come to Boston and undertake the new work, and in July of that year the necessary steps were taken by the formal appointment of the author as Assistant Professor of Biology at the Institute. There were at that time no regular Biological Laboratories excepting a Microscopical and Botanical Laboratory in the "Annex" to Rogers Building (a low, one-story affair, standing approximately where the Walker Building now stands) and this had been done away during the summer of 1883 by the erection of the Walker Building.

The Zoological instruction was given in the basement of the Natural History building by Dr. Alpheus Hyatt, Professor of Zoology, but all the rest of the Biological instruction was now put in charge of the new Assistant Professor. Inasmuch as there was as yet no laboratory available for his uses he was courteously given the part use of the Geological room, which at that time was No. 12 Rogers, occupying the space now subdivided into the rooms occupied by the Dean and by the Instructors in English. There was absolutely no apparatus belonging to the Department inasmuch as the poverty of the Institute had not hitherto allowed the purchase of apparatus. There was

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BACTERIOLOGICAL COURSES

By S. C. PRESCOTT.

It is sometimes said, with seeming extravagance of statement, that the bacteria are the most important organisms in the world, since upon their activity depends our whole organic food supply, and to their efficient behavior we are indebted that the earth is not a vast charnel house rather than a living laboratory wherein are carried on the most important of reactions.

Extravagant as the statement above may seem, it is probably absolutely true for were the bacteria instantly and completely destroyed life would soon become impossible for mankind. Thus bacteriology is at once seen to be a subject of supreme interest to the biologist, the chemist, the sanitarian, and the man of general thought who would investigate and ponder upon the forces of Nature and their influence upon human life and welfare. To the physican and the pathologist it is, of course, a tool, but it is perhaps of equal value to the man of science and technology. This fact was early recognized by Professor Sedgwick, who established the first coure in Bacteriology in the Biological Department in the late eighties. It is probable that the Institute was the first technical school to give instruction in this subject.

The student entering upon his fourth year work in the Department of Biology fifteen years ago was introduced to a one term four-hour course in General Bacteriology, wherein he gained his first experience in dealing with those minute but most effective organisms, the bacteria and their allies. This course, which was given at that time by Prof. Sedgwick with the occasional aid of an assistant, was attended by a mere handful of students, perhaps a half dozen in all. The subject was treated from a broad and general biological standpoint, but so fundamentally and so practically that the course was, to the interested student, a continuous delight, as it opened a new field for unbounded speculation, investigation, and usefulness.

So little had the subject been developed at that period that contrasted with the amount of work done in the Institute laboratories of Bacteriology at the present time, our early course would make a rather insignificant showing. But the great work of Pasteur and Koch

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THE TECH

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BOSTON, MASS., APRIL 2, 1910.

TABLE OF CONTENTS.

The Tech extends its thanks to all those who lent their efforts to the publication of this special issue devoted to the Department of Biology. Especial thanks are due to the faculty and members of the instructing staff in the department whose articles appear in this issue, as well as to the many graduates, who responded so well to the request for graduate letters that lack of space made it necessary to shorten some of the letters.

FRESHMEN VS. E. H. S.

Today, the Freshmen will play the Boston English High School at the Field in their first game of the season. English High usually has a fast team and ranks among the leaders in the Interscholastic School League. A fast practice game is expected. The freshmen have many good men and every man will be given a tryout. Practice begins at 2.00 and the game starts at 3.00.

SOPHOMORES PLAY TODAY

The Sophomores will have a practice game today at Brookline with the Brookline Gym team. The men are to meet at Tech Field at 2.00, and from there they will walk to the grounds. Every man is to be given a chance to get in the game. The game will start with Sloane and Taylor as the battery. Bird and Allen will also play some innings in the box. Whittlesey will catch part of the game. Tarry and Moore will hold down the first bag; Davis will probably alternate with Maguire on second; Reeves plays on third; in the field there will be Coulson, Sage, Maxwell, Hopkins, Stone, Prang and Freedman.

All work on the new Cambridge subway is tied up hard and fast by the strike of 3,000 Italian laborers, which yesterday started at Harvard square at noon, and had spread to the last gang on Main Street by 5 o'clock.

"COCCI" VS. "CYTES"

There will be a baseball game between students of the Biological department and the seniors in Sanitary Engineering at Tech Field, Monday, April 4, at 3 o'clock.

The Biologists have organized for this occasion under the name of "Streptococci." As such they will attempt to convince the "Leucocytes" from Course XI. that baseball is distinctly a Biological phenomena, and can be thoroughly understood only following the completion of a detailed course in Sanitary Science and Public Health. Umpire Salmonde has positively declined to officiate on this occasion.

GENERAL NEWS

WEATHER REPORT.

Forecast for Boston and vicinity: Fair Saturday and Sunday, with little change in the temperature. Light, variable winds.

Memorial Hall, Cambridge, was last night the scene of the annual April Fools Night banquet and rough-house held by the Harvard College boys. From the time the first men come in until midnight there is "something doing" all the time, and they kept up the custom last night. "Comets" made up of several pounds of salt, sugar and other ingredients, wrapped up in napkins, were the favorite missiles. These are tied up in a manner best calculated to allow them to distribute their contents over the persons of the diners, and they fill the bill admirably when projected into space with all the force of the excited merry-makers.

Hot Springs, Ark., Apr. 2—The Red Sox spent yesterday in general practice and team work. The Cincinnati Reds left Hot Springs in the morning.

Atlanta, Ga., Apr. 2.—The Boston Doves yesterday suffered a 7 to 6 defeat at the hands of the local Atlanta team. Pitcher Brown went up in the air in the seventh, and six errors by his team-mates helped to lose the game for Boston.

Chicago, Apr. 2—Commander Robert E. Peary, who arrived in Chicago yesterday, in an interview said: "I am absolutely at the end of my career as an explorer. Reports that I am to lead an expedition into the Antartic regions are not true, and I certainly do not contemplate another trip to the North Pole."

The Harvard engineering camp at Squam Lake, N. H., will open for the summer season of eleven weeks on Thursday, June 23, and will close on Tuesday, September 6.

Halley's Comet, during the month of April, will rise in the early morning before sunrise. On the 1st it precedes the sun by 43 minutes only and, therefore, is lost in the twilight. On the 15th it rises 1 hour 28 minutes before the sun, and on the 30th, 2 hours 8 minutes. It will, therefore, come into view about the middle of the month, and be in still better position as the month closes. May, however, is the month in which the comet will be best seen. In April it will not be conspicuous, but it can be seen without a telescope in the last fortnight of the month.

FOREIGN.

Naples, April 1—Naples is crowded to-night in anticipation of the arrival from Africa early to-morrow morning of Colonel Theodore Roosevelt.

Paris, April 1—The memoirs of Vice-Admiral Fournier, commander of the Mediterranean squadron of the French navy, in which he discusses particularly the possibility of a war between the United States and Japan and the resultant danger of dragging all Europe into a terrific conflict, have been issued in book form. The memoirs have caused something of a sensation in political and diplomatic circles.

NOTICES

FIRST YEAR.

The gymnasium exercises in Physical Training will close this term on Thursday, April 14th. All deficiences must be made up within the next three weeks.

During the last week of exercises assignments will be made by Mr. Kanaly for physical measurements to be plotted on the charts.

Award of Cabot Medals, based on these reports, will be made by the Committee before the end of the term.

ALFRED E. BURTON,
Chairman Faculty Committee on Physical Training.

FIRST YEAR.

SHADES AND SHADOWS.

March 24, 1910.

Exercises in this course will be held on Mondays, 2-3 and Fridays, 12-1, in Room 40A Pierce Building, beginning Monday, April 4, except on May 9, when the Monday exercise will be transferred to Wednesday, May 11, at 2 P. M.

Students are requested to bring to the first exercise T-square, 45 degree triangle, scale, etc.; paper will be furnished. WALTER HUMPHREYS.
Registrar.

Fourth year and graduate students, intending to make application for Graduate Scholarship Aid for the year 1910-11, should file their applications with the Secretary of the Faculty not later than April first.

MILITARY SCIENCE.

All students having a lecture in Mil. Science on Saturday, will report then at the South Armory for Gallery Practice instead of reporting in 25 Lowell for the lecture.

1912.

Sophomore baseball practice at Tech Field every Monday, Wednesday and Saturday until further notice, from 3 to 6 P. M.

1913.

All men who expect to try for freshman outdoor track, report from now on at Tech Field for practice.

The Equal Suffrage Association of Boston University extends a cordial invitation to the student body of the Institute of Technology o be present at a reading of the English comedy, "How the Vote was Won," by Miss Fola La Follette, on Friday, April 1, 1910, at 4.15 P. M. In Jacob Sleeper Hall, cor. Exeter and Boylston Sts.

Pres. Taft will spend Sunday in Worcester, Mass. A parade is to be held in which the President will be escorted by some 50,000 school-children, cadets from military academies, and five State military companies.

FROM A GRADUATE

BIOLOGY AS A PREPARATION FOR TEACHING.

Dear Professor Sedgwick:—

Since graduating from the Institute in 1892, my work as biologist, teacher and sanitarian has depended entirely on my Tech training in the Department of Biology.

For one year, as assistant in Biology in the Department, I taught Botany and Comparative Anatomy.

Then as assistant Biologist to the Massachusetts State Board of Health, involving Miscroscopical analyses of the drinking waters of the State, my training was obtained through a course under Mr. G. N. Calkins, as far as I know, the first course of the kind given in any college.

Later I have served as instructor and professor of sanitary science at Purdue University.

In my teaching experience I have had to teach and in some degree organize classes in Bacteriology, Microscopy, Botany. General Biology, Biology of Drinking waters, Sanitary Biology, Hygiene and Sanitation.

In connection with Public Health work throughout Indiana, in lectures before teachers' institutes and farmers' institutes, in tuberculosis and typhoid prevention work and so on, the special course of lectures on Sanitary Science given by yourself was of inestimable value.

The co-operation between the various sanitary laboratories and the State Board of Health was a factor of great importance in the training, at the time I was at the Institute.

I always look wih pride on Technology as my Alma Master, and with immeasurable gratitude on the various factors which directed me into Course VII.

Very sincerely yours,
SEVERANCE BURRAGE.

LABORATORY TECHNIQUE

By C.-E. A. WINSLOW.

It is of course the aim in Biology, as in other departments of the Institute, to teach principles rather than to attempt to discuss all the details of current practise. A certain amount of technical facility must, however, be imparted in order that graduates may be able to begin their practical work with intelligence. The attempt is made, however, throughout to keep the work along broad and fundamental lines so that its application may be as wide as possible.

The first course of this type, given to entering biologists and to sophomore chemists, is Industrial Microscopy. The aim of the work is two fold, first to acquaint the student quite fully with the practical workings of the microscope and second, to indicate in a general way the various fields in which the application of the microscope is likely to prove useful. Among the subjects first examined are the commoner starches, certain of the more frequently adulterated food products, the chief paper and textile fibres; and the latter part of the course introduce, the student to some special uses of he microscope in biology and geology.

In the third and fourth year two courses of two hours each are offered to biologists, chemists and engineers in the Microscopical Examination of Water and Sewage and in the Bacteriology of Water and Sewage. The first course deals with the microscopical plants and animals which multiply in reservoirs and produce unpleasant tastes and odors, the second course with the standard procedures in use for the sanitary examination of water supplies. In the development of current practice in both these fields Institute workers have played a predominant part and somewhat unusual opportunities are afforded for attaining technical skill and intelligence in the interpretation of results.

Finally the diagnostic methods of state and municipal laboratories are taken up in a three-hour course in the fourth year of Course VII. This work is under the general direction of Dr. F. H. Slack, director of the laboratory of the Boston Board of Health. The standard diagnostic procedures for diphtheria, tuberculosis, typhoid fever, malaria and rabies are studied in some detail, and although no one can be expert in this particular work without a long period of practical experience, the student is well qualified to go into any laboratory and begin work under the most favorable conditions.

GRADUATE LETTERS

Mr. S. Henry Ayers.
Dear Professor Sedgwick:—

Since my graduation from the Institute in 1905 my professional work has been entirely along the lines of bacteriology were of the greatest value during the past four years has been dependant entirely upon courses of study which I took in the Biological Department of the Institute. I have of course found that the courses in facteriology were of the greatest value to me since they form the backbone of my work. In my present position as Bacteriologist in the Dairy Division, U. S. Dept. Agriculture, I am constantly engaged in research work along lines identical with courses given me in the Biological Department. In research work it is essential that the investigator be a careful observer and aside from the practical value of my courses the general training, the development of the power of observation which I received at the Institute is of the greatest value to me. Above all I cannot express the value of my association with the Instructing staff of the Biological Department whose personal interest in the students seems to me to be one of the most valuable features of the Department.

Very sincerely yours,
S. HENRY AYERS.
Dairy Division U. S. Dept. Agric.
March 9, 1910.

Dear Prof. Sedgwick:—

Henry Ward Beecher was once asked, by an interested listener, how long it had taken him to prepare that day's sermon. "A life time" was the unexpected reply. And I feel somewaht of the same mind when asked to express in short letter the value of our Biological course to me in my chosen profession,—a course, to my mind, more valuable, if you will pardon a personal reference, by your keen insight into the needs of and your personal influence upon each pupil.

I entered upon Course VII. with the plan of getting a broader foundation, especially of co-related subjects, for medical study.

Owing to the smaller attendance upon the Biological Course, the pupil derived immediate benefit from individual instruction and I shall never forget your quick discovery of my own weaknesses and I was soon made conscious of the fact that I had never before known how to study.

Among the essential qualifications for a skilled physician are to be included intelligent observation, delicate manipulation, interpretation, precision, quick, perception and decision all of which are more or less conscious developments in your technical fitting for graduate medical study.

As a result of this preparation, I was able to take advantage of much practical work at an earlier stage of my medical studies than could have otherwise been possible.

I would not hesitate to advise a similar course of preparation to any aspirant to medical learning, feeling confident that the extra hours of hard work more than pay for the advantages thus obtained.

I am exceedingly glad to have had this opportunity of expressing myself on what I have learned to consider essential in medical training.

Always most cordially your grateful pupil, J. ARNOLD ROCKWELL. '96.
March 12,1910.

APPLIED BIOLOGY.

It is a pleasure to acknowledge the admirable training my work in Course VII gave me for the position I now hold, with the Superior Water, Light & Power Company.

The courses in applied biology, such as the Bacteriology of Water and Sewage, Industrial Biology, Microscopy of Water, etc., as well as the work in Sanitary Chemistry, have all been of vital importance in my routine work. The Senior work in Sanitary Science, and particularly Professor Sedgwick's lectures to Course VII. on Municipal Sanitation, gave me an expert knowledge of health work which has been of great help to me in establishing my position as a water expert in this community.

I feel that every course in the regular work, excepting only that in comparative anatomy, has been of direct benefit in my professional work.

As I look back over the years spent at "Tech," it seems to me that Course VII is a course peculiarly adapted to fit one to take positions of responsibility and trust in various municipal lines and especially water works management.

Very respectfully.
WILLIAM C. LOUNSBURY,
(Course VII, '04).

Dear Professor Sedgwick:—

In my work as classifier of books in the John Crerar Library of Chicago and in the Library of Congress in Washington, I have been able to utilize practically everything I have ever learned and as I have gone more deeply into the biological sciences than any other they have been especially useful to me.

In the Library of Congress which is now nearing the completion of the work of reclassifying its enormous collection of more than 1,700,000 volumes, I began as classifier of Technology but I have since then gradually assumed charge of classification in Geography, Authropology, Science, Medicine, Military and Naval Sciences and Fine Arts.

In biology, botany, zoology, bacteriology, anatomy, physiology, in sanitary science, and in medicine the technical knowledge was acquired in the course in Biology at the Institute has been extremely valuable to me as an educational influence affecting my whole life and I consider this course, both for its technical training and as a liberalizing education, as worthy of the highest respect and admiration.

Very sincerely yours,
CLARENCE W. PERLEY.
March 7, 1910.

ZOOLOGY

By R. P. BIGELOW.

Since the days of Darwin and Huxley's famous essay on Man's Place in Nature it has become generally recognized that man is an animal, and that his structure and activities and even his mental life can be understood only by reference to a long line of animal ancestors. Therefore some knowledge of Zoology, the branch of biological science that deals with animals, is a desirable addition to any scheme of general education, and of course in biology it is necessarily an mportant feature.

The first instruction in zoology comes in the course in General Biology, when a few lowly animals are studied, together with plants, to illustrate general principles of biological science. The student in Course VII. enters upon the study of zoology for itself in the second term of the second year when he takes the course in General Zoology. In this course there are one lecture and two hours of laboratory work each week, and the aim of the course is to give a general survey of the animal kingdom, which will be of value in itself as a part of the general fund of information of an educated man and at the same time form a foundation for future biological study.

In the first term of the third year there is a division of the students in Course VII. into two groups, those electing Option 1 (pure biology(, and those electing Option 2 (applied biology). The men taking Option 2 enter upon the study of the comparative anatomy and development of the lower animals. These subjects are treated from the point of view of the theory of organic evolution and the student has unfolded before him the progressive stages in complicity of structure from the lowest to the most complete along each of the lines of evolution that constitute the main divisions of the animal kingdom. This is done not only by the comparison of the adult structures but also by a study of the life histories, which sometimes reveal unexpected relationships between higher and lower forms. In the laboratory students have an opportunity to become familiar with the chief types of structure by means of careful dissection of a representative from each great group.

For all students in Course VII. the greatest amount of work in Zoology comes in the second term of the third year. This term is devoted to the study of the back-boned animals, of which man himself is the culminating type.

Students in both options take two courses at the same time, one in the gross Anatomy of Vertebrates and the other in Microscopic Anatomy, or Histology. In these courses the emphasis is on quality rather than quantity of work. There are few lectures and there is much laboratory work, and the student is expected and encouraged more than ever before to find out things for himself.

In the course in Vertebrate Anatomy only two or three types are studied, but these are studied very thoroughly by means of dissections, from which detailed drawings are made.

In the course in Microscopic Anatomy attention is confined to the minute structure of the mammals, which is studied in its relation to the origin of the different parts in the development of the individual, and the text-book used is one on human histology. In this course the student prepares a series of specimens to keep for his own use.

It is believed that these courses are of value from two points of view: First, they are valuable as an exercise in a scientific method that is perhaps of more general application in the ordinary affairs of life than the experimental method, that is the method of direct observation and analysis of nature, without previous human interference, followed by mental reconstruction of the the whole from its parts; and second, they are valuable as a source of information that is necessary for the understanding of human physiology, which in its turn forms to a great extent the scientific basis for the practice of hygiene and the preservation of the public health.

In addition to these courses students who have elected Option 1 take a course in the Embryology of Vertebrates. While the lectures cover the general field of the development of the individual in the main divisions of this group, treating in a compartive way the history from the egg to the fully formed animal, the laboratory work, as in the previous courses, is confined to a few types. The students prepare for their own use frog and chicken embryos and have an opportunity to study a fine series of mammalian embryos kept for that purpose in the laboratory collection.

Since Pasteur's study of the diseases of silk worms and Koch's discovery of the bacillus of tuberculosis an ever-increasing number of small plants known as Bacteria have come to have a bad reputation as the cause of most of the ills that man is heir to. Within recent years, however, it has become evident that many of the troubles of men and domestic animals, not to mention wild ones, are due not to Bacteria, but to animals, some of them microscopic, others by no means so small.

For example, malaria, sleeping sickness, tropical dysentery, the Texas fever of cattle, and the horse sickness of South Africa and the Philippine Islands are known to be due to microscopic animals, and there is reason to suspect that small pox and scarlet fever may have a similar cause. Some of these diseases are carried from one victim to another by blood-sucking insects, while some of the troubles of men and lower animals are due to the direct infection of the intestine by parasitic worms, as, for example, the hook-worm disease that has been such a serious addiction in our Southern States and Porto Rico.

The importance of this subject from the pont of view of the public health has led to the establishment of a course in Invertebrate Zoology, or more properly Parasitology, given to all students in Course VII. during the first turn of the fourth year. This is a course of lectures with demonstrations and covers the subject of the classification, structure, and life-histories of the animals which may affect the health of man and the domestic animals.

For Option 1 there is offered in the second term a course in Experimental Zoology. This is really physiology, but differs from the course given under that title by treating the subject from a different point of view. Here we are not concerned so much with the physics and chemistry of the body as we are with the reactions of the body to external conditions. As these reactions are shown in their simplest form in organisms low in the scale of being, attention is confined chiefly inthe course to the primitive forms of animals. Studies are made on the reactions to light, heat, and electricity, to gravity and to various chemical substances, on the factors influencing develpoment, and on the effects of mutilation and the method of repair. Thus may be obtained an insight in to some of the properties of the living substance and indirectly a better understanding of the factors affecting the life of mankind.

PHYSIOLOGY

By PERCY G. STILES, Ph.D.

In the early years of the department, when the regular students were trained as teachers of the Biological Sciences or prepared for Medical Schools, Physiology was obviously important and much time was devoted to it, in both terms of the senior year. With the widening opportunities for workers in Sanitary Science our students have so generally chosen that field of activity that Physiology has been set back to the junior year and compressed into one term. It is clear that its more special aspects are not directly of interest to the bacteriologist. Nevertheless, the retention of the present condensed courses is easily defensible. The life activities of the lower organisms are far better understood when one has some knowledge of the more complex transformations of matter and energy wrought by the higher forms. It is aimed therefore to teach Physiology in a general and comparative way with little emphasis on anatomy but much on the dynamics and the economy of animal cell-systems. The writer cannot refrain from a word in regard to the educational value of the subject. There are few sciences which so constantly call for the sifting of conflicting evidence, for discreet inference, and for the suspension of judgment in default of data. The last faculty is certainly a valuable one and not too common.

The required Laboratory Physiology is of an elementary grade. The experiments illustrate salient properties of the blood, of the muscle and nerve, of the rhythmic heart-tissue, and of enzymes. The work usually supplements the lecture course, but it may be taken separately by students who have had previous instruction in the theory involved. Those who develop a taste for physiological research may pursue special lines in the senior year or return to it in graduate programs. In the past fifteen years the Theses in this Laboratory have furnished material for several published papers. Among the topics treated have been Neuro-muscular Fatigue, Changes in the Capillary Circulation, Tffects of Ions upon Contractile Tissues, Conditions of Enzyme Action. Summer investigations are encouraged.

The short course entitled Personal Hygiene is given in the second term of the senior year. It is intended primarily for those who have had Physiology in the preceding year. Assuming this preparation the instructor aims to make the lectures and conferences scientific rather than dogmatic. The method is not to state many rules for the conduct of life, but to test the probable validity of traditional teachings in regard to these matters. Current views of diet are considered, quantity and kind of food, Fletcherizing and other fads, water-drinking and emotional factors affecting nutrition. The much abused subject of alcohol is discussed judicially. The relation of the vasomotor system to health and resistance receives close attention. The far-reaching effects of muscular activity are brought out at some length. The attempt is made to estimate the scope—and the limitations—of mental states in the preservation of health and the righting of disorders. Rest, variety of occupation, and sleep are kindred subjects which have a place in the course.

BACTERIOLOGICAL COURSES

(Continued from page 57.)

had been done, Bacteriology had become a science, investigation was proceeding everywhere, and the parent stock from which development was to take place was strong and vigorous. Year by year advance was made, and in fifteen years the Bacteriological courses have grown in number from one, taken by an average of five students yearly, to six in which the annual enrolment is approximately a hundred. These figures represent with fair accuracy the development of the science during this time. Our one general course has been much extended, while specialized courses in the Bacteriology of Water and Sewage, Industrial Microbiology, Zymology, and Municipal Laboratory Methods have been established as our knowledge of the bacteria and their manifold special activities has increased. Moreover, the course has appealed to a wider clientele than at first, Originally designed for the biologists alone, we now find two or more of the bacteriological courses in the curricula of the Chemical and Sanitary Engineer-departments as well.

Following the principles laid down in the early work, the backbone of our bacteriological courses has been General Bacteriology. While the work has been greatly extended in scope and amount as noted above, its purpose remains primarily the same as in the early days, namely, to give to the student a broad knowledge of the bacteria as a group of organisms, of their distribution in soil, water, air and elsewhere, and their structure and physiology, their mutual relations with the environment, and their more intimate relations to the human organism as parasites or commensals. In the latter connection the student is naturally led to a consideration of the germ theory of disease,—next to the theory of evolution itself the greatest triumph of nineteenth century science,—and the relation of specific types of bacteria as causative agents of infectious disease. Particular emphasis is laid on importance of the germ theory, since it supplies the basis for general preventive medicine and all our special sanitary work in the safeguarding of water, food, and milk supplies, and the disposal of waste such as sewage. On the other hand, the student gets a very distorted idea of the great group of bacteria, in which after all the useful types far outnumber the dangerous ones, if undue emphasis is laid on the disease-producing bacteria in the beginning of the course. The thoughtful student is quite as much impressed with the importance of the germ of typhoid fever and its relation to the public health and much better able to cope with it if he knows also that in its biological relations it behaves like harmless and useful types, just as murderers and bank robbers have the same physical necessities, the same senstiveness to heat, cold and poisons as the honest and helpful members of society. The additional knowledge that certain species have specific powers of the most destructive character serves at once to stamp them as dangerous individualsfi to be feared if at large, and to be fought intelligently and unceasingly by the weapons which general knowledge of the group and special knowledge derived from the investigation of the organism itself puts into our hands.

Our general course, therefore, is intended to give breadth of knowledge of the individual organism and of the methods by which particular characters of the individual may be accurately investigated.

To go from the general to the specialized phases of a subject is the logical method of procedure. Hence it is that after gaining our general knowledge of the microbic world we proceed to the study of special divisions of it. Thus our courses in Bacteriology of Water and Sewage, Industrial Biology, and Municipal Laborotory Methods (really a course dealing with preventive and diagnostic work) rest upon and follow our broad general course.

Twenty-five years of experience has taught that the fitness of a water for human consumption in general can be best determined by its investigation from the bacteriological side. The trained bacteriologist can not only recognize the types of bacteria which are normal to the water, he can also detect the presence of the undesirable, dangerous, and semi-parasitic forms which we now know to be characteristic of pollution and absent in pure waters. The biologist may therefore work hand in hand with the engineers, or as in the case of the sanitary engineers, the knowledge of special methods of investigation on the sanitary side may be added to an engineering equipment. Special attention has been given to these matters in the Biological Department for many years, and it is only necessary to note the work done by Institute men with this training to learn how serviceable Technology has been in the public sanitary service.

In a somewhat similar manner the course in Industrial Biology directs the attention toward the industries in which micro-organisms play an important part. The enormous food preserving, canning, cold storage, and allied industries are esentially biological industries. The dairy industry in all its phases requires highly specialized knowledge of the bacteria and moulds, and of their control, propagation, or destruction, in order to be carried on with the highest efficiency. All the fermentation processes, manifold in character and usefulness, involve the activity of germs of one sort or another. Space does not permit an extended discussion of the scope of this work. The course in Industrial Biology brings to the attention of the student some of the more obvious of these bio-chemical processes, but aims to do more than that, that is to give so comprehnsive an idea of the chemical activity of micro-organisms and their posibilities that inquiry and investigation will be stimulated along new and untried lines. Unquestionably, the future will see a great expansion in the utilization of bacteria, in chemical manufacturing, in agriculture, and in the preparation of foods and beverages. It can hardly be doubted that advanced scientific agriculture will depend to a great extent upon the progress that can be made in soil bacteriology. In the general movement for conservation of natural resources it is safe to predict that the biologist will have a place along with the chemist and the engineer.

The more theoretical side of the problems of fermentation and putrefaction is considered in the course in Zymology. The enzymes, as the chemical reagents by which the micro-organisms eary on their reactions, form a group of substances of great interest. Study of them has already explained many otherwise mysterious processes, and the field is still comparatively untilled. Isolated facts are known, but much remains to be done in the grouping and classification of these facts.

Taken together the courses based upon knowledge of the bacteria form a well co-ordinated group, combining theory and practice, and all tending to render the receptive student capable of becoming of great service to his fellow man.

RESEARCH LAB. AND SEWERAGE EXPERIMENT STA.

By EARLE B. PHELPS.

In the fall of 1902 the Institute received from an anonymous friend the sum of fifteen thousand dollars for the purpose of making a three years' investigation of the problem of sewage disposal as it applies to large cities. The following purposes were specified: (1) For keeping up with the investigations of the best men in all countries. (2) For utilizing this knowledge in the work of the Institute. (3) For original experiment. (4) For distributing all over our country, in such words that he who runs may read, the results of the work. (5)And for inciting the students to make plain and simple statements of the results of their work. In this gift the Sanitary Research Laboratory had its origin and by the continuing generosity of the donor it has been supported to the present time

Work was immediately begun under the direction of Professor William T. Sedgwick and in the immediate charge of Professor C.-E. A. Winslow, Members of the staff of Biological Department and seniors and graduate students in Biology and Sanitary Engineering have been actively associated with the work from the first.

A location was secured at 786 Albany street, on the line of the nine-foot trunk sewer of the Boston main drainage system. Here were installed during the first year the necessary pumping and distributing systems and a series of twenty-two tanks and filters covering in the broadest way the various known processes of sewage treatment. The plant was first put in operation in July, 1903. During the first two years a general survey of the field of sewage disposal was made. Sand filters, septic tanks, contact and trickling filters, and processes of aeration and clarification were submitted to detailed study under carefully controlled and known conditions. The results were measured by chemical and bacteriological methods and physical and engineering data, having reference to the design and cost of works, were collected. Simultaneously an investigation of the amount and character of the sewage of Boston was undertaken. This involved continuous, twenty-four hour tests at various seasons of the year to determine the hourly, daily and seasonal variations and the average character of the sewage.

The results of this study on the crude sewage of Boston, together with special papers on analytical methods were published in 1905, as Volume 1 of the "Contributions from the Sanitary Research Laboratory." A conspicuous feature of the laboratory has always been the improvement of analytical procedure and in this first volume, as in subsequent papers, new methods of chemical and bacteriological procedure were recommended, which have later been adopted as standards. In the following year, 1906, Volume II. of the "Contributions" was published. This volume is a detailed report of the first two years' experimental study, with a history of the sewage disposal problem and a resume of investigations of others at home and abroad. The U. S. Geological Survey considered this paper of sufficient practical importance to justify its publication and general distribution as a government document.

Since 1906 three additional volumes of "Contributions" have appeared, these being made up of reprinted papers written by members of the laboratory staff upon special topics relating to sewage and water purification and allied topics. In the third volume the results of the second two years's experiments are reported, while in the next volume a detailed plan for the disposal of Boston's sewage with estimates of the cost of the project is given. In Volume V. Professor Winslow's investigations of the bacteria in sewer air and the writer's work in the new field of chemical disinfection of sewage are reported.

In June ,1909, the Albany street plant was given up and new and larger filters were installed at the Old Harbor Point Pumping Station, Dorchester. The office and laboratory were removed to the Pierce Building.

SANITARY SCIENCE

C. E. A. WINSLOW.

The special development of the Biological Department has been along the lines of the public health sciences, and this is likely, in the future, as in the past, to constitute its principal field of usefulness. There is a wave of sanitary reform sweeping over the country which leads to an ever-increasing demand for well-trained specialists. The chief factors in the war against disease are the medical expert, dealing with the individual, and the engineering expert, dealing with the environment. Second only to these two professions, however, are the public health bacteriologist, the sanitary chemist and the vital statistician and specialists of all five types are urgently needed by state and municipal board of health. It is the aim of the Biological Department to train public health bacteriologists and to furnish to men in Course V. and Course XI. the biological part of their equipment as sanitary engineers and sanitary chemists.

The Institute, under Professor Sedgwick, has taken a unique position of leadership in the work of public health reform all over the country. In water supply sanitation and in sewage disposal a majority of the leading experts are probably Tech men, and the demand for our graduates greatly exceed the supply. Only an adequate number of the right kind of students is necessary in order that the Institute may retain its position, which Mr. G. C. Whipple '89 has described in the dedication of his book on typhoid fever, "To the Massachusetts Institute of Technology. My Alma Mater A Pioneer in Sanitary Education, entitled to the Gratitude of every one who values The Public Health."

The fundamental course in this branch of the Biological work is a brief lecture course on sanitary science and the public health in which are discussed the fundamental principles of health and disease, the causes and vehicles of disease. the spread of disease by water and sewage and milk and insects and the general phenomena of immunity and vital resistance. This course is now given, not only to those students who are specializing in sanitation, but also to Option 1 in Course I. and to Course IV. It would be of great advantage if such a course were included as required work in all departments, and the day is likely to come when this will be done, not only in the Institute, but in all institutions of higher learning. It is a quite unreasonable procedure to teach the student about the various engines and motors he is likely to meet with and to give him no information, except for five lectures in the freshman year, about the complex living machine it is certain he must operate. The technical graduate furthermore is not only responsible for his own health, but often for that of many others. The time must come when such men will no longer be sent out merely to serve as food for typhoid and tubercle bacilli for the want of simple instruction in sanitary science.

For the Course VII. and Course XI. men, the next work in importance is a two hours (XI.) or four hours (VII.) course in Municipal Sanitation. Here the sanitary aspects of water supply, sewage disposal, garbage disposal, air supply, and board of health administration are considered in some detail and illustrated by visits to various plants in operation in the neighborhood of Boston. Course VII. men have next a course in Industrial Hygiene in which factory accidents, industrial poisonings and factory dust, in relation to industrial tuberculosis, are discussed. This is one of the fields in which the Institute has done pioneer work, and it is believed that no course of similar scope is given in this country. Finally in the fourth year in Course VII. informal conference courses are conducted in Public Health Problem, Epidemiology. and in the Biology of the Infectious Diseases, completing a general survey of the principles which govern the causation and prevention of environmental disease.

The Sanitary Research Laboratory offers unusual facilities, to properly qualified students, for the study of problems relating to the purification of water and sewage, the disposal of industrial wastes and allied topics.

HISTORY OF DEPARTMENT

(Continued from page 57.)

available, however, a fair supply of miscellaneous microscopes which had been used in the old brick annex by Professor and Mrs. Ordway (who had given the instruction in Microscopy and Botany) and the basement laboratory belonging to the Natural History Society contained the necessary microscopes for the Zoological classes. Professor Ordway very kindly loaned his collection of microscopes to Professor Sedgwick for the first year, and before the end of 1883-4 the large room which is now occupied by the General Library, and which had up to that time been used as the Physical Laboratory, was now vacated by the Department of Physics and turned over to the new Department of Biology.

At the beginning of 1884 this large and excellent room was well fitted up with microscopes and simple physiological apparatus so that work began in real earnest in the autumn of that year. The first Assistant in Biology was Professor Sedgwick's friend, Dr. Edmund B. Wilson, afterwards Professor of Zoology in Columbia University and now one of the most eminent of living biologists. He was succeeded by Dr. Edward G. Gardiner, a graduate of the Institute from the Natural History Department in 1882; but for the first year or two whenever Professor Sedgwick left the laboratory he was obliged to lock the door and take the key with him, because he had no assistant, janitor, or other person to leave in charge.

The Department grew very slowly and for a number of years led a precarious existence. Owing to the unwillingness of the better medical schools in the vicinity to allow preference to men trained in Biology, the hoped-for developments along the line of preparation for medical studies was not realized, and it was not until the rise of Bacteriology, which began to make itself felt in the Department in 1886 and 1887, that any considerable progress was made.

In 1888 Professor Sedgwick was invited to become Biologist to the State Board of Health, and this appointment, together with the opportunities which it gave for research in the new Science of Bacteriology, obviously destined to be of immense importance in the world, gave the Department a recognition and importance which could not be overlooked.

The first graduate of the new Department to win distinction in Biology was Mr. Edwin O. Jordan, of the class of '88, now Professor of Bacteriology in the University of Chicago, author of one of the most scientific and important manuals of Bacteriology hitherto published in the English language. The class of 1890 included the present Medical Adviser of the Institute, Dr. White, and Mr. John L. Batchelder, Jr., now one of the prominent business men of Boston and devoted in every way to the welfare of the Institute. The class of 1892 included A. P. Mathews, now Professor of Physiological Chemistry in the University of Chicago; Severance Burrage, Professor of Sanitary Science in Purdue University, Indiana; and Dr. A. M. Worthington, an instructor in the Harvard Medical School; and from that time forward many others of promise have come out from the Department as graduates, together with a host of college men and others not bearing the formal Institute hallmark, who have nevertheless borne out into the world with them Institute traditions, Institute training, and Institute ideals.

CHEMICAL BIOLOGY

EARLE B. PHELPS.

Chemical Biology may be defined as that branch of biology which deals with the application of the laws of physico-chemistry to the phenomena of life. To what extent such application is justified and why it is attempted are questions that at once suggest themselves. Whole philosophies have been written upon the respective conceptions of "vitalism" and "mechanism." Neither school of thought can be adequately defined in a few words nor is the line of demarcation a distinct one. Briefly the mechanistic view holds that the secret of life lies in the fundamental laws, known and unknown, of the interactions of matter and energy, and that a complete knowledge of these laws will furnish the full answer to the riddle of life. Vitalism on the other hand assumes, and oftimes attempts to demonstrate, by a priori reasoning, the existence of some guiding force, external or internal, which may suspend or supercede or otherwise inactivate the known forces of nature. The first law of energetics has even been made to yield to this "lebenskraft" or "force hyper-mechanique. Today the first law is admitted by even the most ardent vitalist, but the second law is not supposed to be inviolable.

The remarkable results which have followed the application of the laws of energetics to chemistry, have opened a new field to the biologist. The present course is an unprejudiced attempt to apply some of these results to the phenomena of life.

The velocity of reaction and its temperature co-efficient are illustrated in various vital reactions. Chemical equilibrium is seen to underlie many remarkable automatic mechanisms of the body, including the heart-beat, and to furnish a partial explanation of organic synthesis. Osmotic pressure and semi-permeable membranes help to elucidate many puzzling problems in secretion and the specific properties of certain colloids furnish a clue to the nature of the enzymes.

No attempt is made to "explain" life but the individual phenomena of life are correlated as far as possible with those of physical chemistry.

FROM DR. WHITE

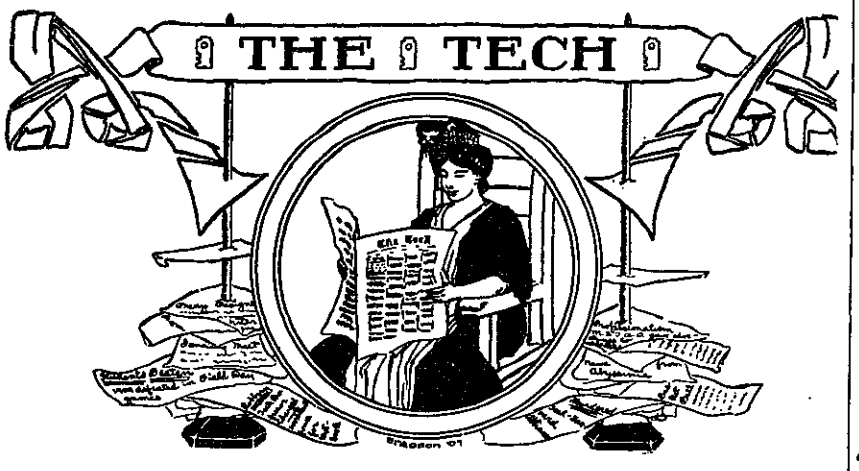
BIOLOGY AS A FOUNDATION FOR MEDICAL TRAINING.

It is with the greatest pleasure that I write a few words about the value of the work in the Biological Department at the Institute.

I believe that a course in general biology such as I enjoyed is the most valuable foundation possible for productive medical work. The thorough early training in scientific observation, deduction, and criticism as practised in the Biological Laboratory has been of the greatest possible value in my work in medicine in giving breadth of view, in avoiding empiricism, and helping me to attack the problems of health and disease in a scientific spirit. The earnest desire to contribute something each year to medical knowledge by experimental work or by the scientific observation of sick persons (in addition to carrying on the routine of medical practice) dates back to the early training and inspiration of the work in the Biological Laboratory.

The early laboratory training, since I learned there familiarity with foreign literature and practice in looking up and judging of foreign contributions to science, has proved very useful. And best of all these good things, and the source of all was the opportunity of personal contact with the genial and vigorous head of the department.

Most sincerely yours,
FRANKLIN W. WHITE.



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BIOLOGICAL SOCIETY

By J. SCOTT MacNUTT.

The youngest of the professional societies at the Institute, the Biological Society, has good reason to be proud of the continued growth and prosperity which it has enjoyed since its founding a little over two years ago. An informal dinner held in the Union in December, 1907, by students and instructors in Courses VII, XI and V, suggested the need of a permanent society to plan and carry on such meetings. A society was therefore formally organized Jan. 7, 1908, and held its first regular dinner Feb. 19. From the very first, the interest shown by students and instructors in the Departments of Biology, Chemistry and Sanitary Engineering indicated that a real social need had been filled. At the first dinner, Professor W. T. Sedgwick, Head of the Department of Biology, addressed the Society on "The Outlook for Biology and Sanitary Engineering in the Twentieth Century." At the second dinner a thoroughly enjoyable lecture was given by Mr. Wm. Lyman Underwood on "Canoe and Camera in the Wilds of New Brunswick," illustrated by remarkable colored views. The first term of the Society's activity closed with an illustrated lecture on "Typhoid Fever" by Mr. Geo. C. Whipple, I, '89, the prominent consulting sanitary engineer. This was the occasion of the first public presentation of the diagrams and other substance of his then just completed and now well-known book, "Typhoid Fever."

The above speakers and subjects are fairly representative of the varied and interesting meetings which the Society enjoys. The object in arranging the social meetings, which are always made the occasion of dinners, is two-fold: to give members and their friends opportunities to hear informally prominent biologists and sanitarians, and men from various branches of professional life related in any way to the work of the Department of Biology, and, also, to provide evenings of good fellowship and recreation

The Biological Society, though primarily intended to promote interest in the subjects of biology and sanitation, at the same time ranges over a wide field of professional interest and attracts men from many directions. This follows naturally from the fact that a considerable number of men from other departments take courses in Biology. There is a large and growing membership of men from the Department of Sanitary Engineering, and the Chemistry Department is well represented.

In addition, there are a number of associate members from other courses who are attracted by the entertainments and the chances to hear good speakers on subjects of general and professional interest. By drawing a considerable number of its members from outside of the Department, the Society has, without detracting from the interest due the other professional societies, provided a common meeting ground for men of related courses and interests, and has also grown to be very enjoyable cosmopolitan in character.

No more is needed to show the prosperity and spirit of the Biological Society than the recent banquet on the occasion of Professor Sedgwick's departure for six months in Europe. Addresses by prominent men, guests of the Society, from both within and without the Institute walls, music by the Society "Philharmonic" orchestra, and a clever vaudeville, were received enthusiastically by a gathering of over one hundred men. On this occasion the Society presented to Professor Sedgwick a gift to accompany its "Au-Revoir," a handsome pair of field glasses.

The Society now has a membership of 50, and the officers for the term are as follows: President, G. T. Palmer, VII, '09; Secretary, J. H. O'Neill, XI, '10; and Treasurer, W. F. Wells, VI, '10.

Looking back on a two years' career which has proved in every way entertaining and profitable, the Society beholds the prospect of ever-increasing interest and growth in the Departments of Chemistry, Sanitary Engineering, and Biology.

GENERAL BIOLOGY

(Continued from page 57.)

who cannot pursue biological work further, but desires to gain a general insight into this field of science. It is somewhat strange that biology should not be required of all students of the Institute, as are the companion sciences of chemistry and physics. No study can have a broader cultural value than one which deals with the relation between the living and teh non-living world, with the problems of organization and the division of labor, as manifested in the living machine, with the inter-relations of competing and co-operating individuals, and the gradual unfolding of the organic world in the great process of evolution. Nor can any science boast so direct and vital an application to the practical conduct of life, which is the ultimate aim of education.

Theoretical Biology. The course in Theoretical Biology is given to students in Course VII. in the fourth year, in order to bring them in touch with the more important phases of advancing research in biological theory. It is designed to give an intelligent comprehension of the general trend of present-day research, such as a biologist in any field should possess, and to interest the exceptional man in the pursuit of investigation for its own sake. In the first term attention is devoted chiefly to the individual organism. The physical and chemical bass of protoplasmic action are discussed, modern theories of response are reviewed and considerable attention is given to the problems of development, regeneration and regulation in general. Correlation and variation are the last subjects considered in the first half of the course. In the second half year all the time is devoted to the evolutionary process. The work of Darwin and his percursors is described, the evidence for organic evolution is reviewed in detail, and the newer theories of species formation, under the influence of various external and internal factors, are discussed.

GRADUATE LETTERS

Some twenty years ago I had to decide what course to select in pursuing knowledge. I decided on chemistry and got a good start along that line when one day I happened to go over to this Biological Laboratory to consult with Prof. Sedgwick about my eyes, with which I was having some trouble. (The reason I went was because Prof. Sedgwick in his talk to freshmen gave them to understand that he would be glad to give free advice to the halt and blind.) The strangest thing about it all was that after I was properly fitted to glasses I could see Biology in larger letters than Chemistry—so this change of heart came with the change in vision—a larger horizon as it were, and I made the transfer.

Course VII under Professor Sedgwick and largely through his personality and association has done much for me in a general way. I have felt and shall feel through life that it was our very greatest privilege to have been under his guidance and to have felt his broad influence and truth seeking spirit.

SIMEON C. KEITH, JR.

The value of my course at Technology is not confined to the instruction that it afforded in the specific subjects undertaken. Of immensely greater value is the knowledge that it imparted of how to observe and to learn. The work that I am following is, nearly all respects, entirely foreign to that pursued at the Institute. Less than 10 per cent of the required subjects in Course VII. are at present of direct utility, yet if I were to direct the course of a young man for the engineering profession, I would place him under the influence of the broad ideals of instruction in Course VII.

After all, the real problem is to teach the student how to study, to observe, and to think logically. Give him these factors as a basis and he will readily absorb the details of any specialty and, morever, will absorb them in a far more purposeful way than he possibly could if his course of study were confined entirely to ready-made details.

GRADUATE LETTERS

The training which I received in the Biological Department of the Mass. Institute of Technology has been a constant advantage to me in later work.

It served as an excellent preliminary education for a medical course at John Hopkins' University, and since then has been especially valuable in the particular field of medical research that I now am engaged in. My energies at present are directed towards determining underlying causes and methods of treatment of rheumatoid arthritis and chronic joint diseases; and the fundamental principles of biology, physiology, chemistry and bacteriology which were taught in the biological course at the Institute have been the greatest service in interpreting the obscure and confusing variety of symptoms and manifestations that are met with in these poorly understood diseases.

Very sincerely yours,
HERMAN W. MARSHALL.

My Dear Professor Sedgwick:—

In reply to your letter of March 1st, I wish to say that I couldn't have filled my position successfully had it not been for the all-round character of the Institute training.

The body of information in the courses offered has always been of practical use, in suggesting resources for subsequent work. The admirable co-relation of subjects in Course VIII intensified, for me, the interest in each course, because it enabled me to approach it from a broader point of view. The laboratory and other manual work that paralleled the lecture, class-room and reference exercises gave me a "know how" not to be acquired in any other way, and, best of all, I have learned patience with hard work and faith in its efficacy when cheerfully and honestly done.

Sincerely yours,
ANNA B. GALLUP,
Children's Museum, Brooklyn Institute of Arts and Sciences.